



Altair

HyperWorks®

Midsurface Option (12.0)

-
- **Auto Midsurface**
 - Surface pair
 - Quick edit
 - Assign target
 - Replace edge
 - Extend surface
 - View thickness

Auto Midsurface

✓ Midsurface > Auto Midsurface

➤ Closed solid

<input checked="" type="radio"/> auto midsurface	▼	surfs	⏪	extraction options...	extract
<input type="radio"/> surface pair	⬆	closed solid			sort
<input type="radio"/> quick edit					reject
<input type="radio"/> assign target					
<input type="radio"/> replace edge					
<input type="radio"/> extend surface					
<input type="radio"/> view/assign thickness					return

➤ incomplete solid panel

<input checked="" type="radio"/> auto midsurface	▼	surfs	⏪	extraction options...	extract
<input type="radio"/> surface pair	⬆	incomplete solid			sort
<input type="radio"/> quick edit		<input checked="" type="checkbox"/> select connected surfaces			reject
<input type="radio"/> assign target		<input checked="" type="checkbox"/> outbound normals (red)			
<input type="radio"/> replace edge					
<input type="radio"/> extend surface				⬆	color display normals
<input type="radio"/> view/assign thickness				⬆	fix normals
					return

Extraction Options

<input checked="" type="checkbox"/> insert planes	<input checked="" type="checkbox"/> no thickness bounds max thicknesses ratio: 1 0 . 0 0 0	<input checked="" type="checkbox"/> extract by component
<input type="checkbox"/> allow rerun	max R/T ratio 2 0 . 0 0 0 <input checked="" type="checkbox"/> thickness based stitch tol	<input checked="" type="checkbox"/> result in Middle Surface comp port Middle Surface comp into:
<input type="checkbox"/> use base surfaces		<input type="checkbox"/> <~[o]riginal name> comp
		<input type="button" value="return"/>

<input checked="" type="checkbox"/> insert planes	<input checked="" type="checkbox"/> keep sides geometry <input checked="" type="checkbox"/> keep step jumps	<input checked="" type="checkbox"/> keep sides geometry <input checked="" type="checkbox"/> align steps <input checked="" type="checkbox"/> auto mid position	<input checked="" type="checkbox"/> keep sides geometry <input checked="" type="checkbox"/> align steps <input checked="" type="checkbox"/> user mid position
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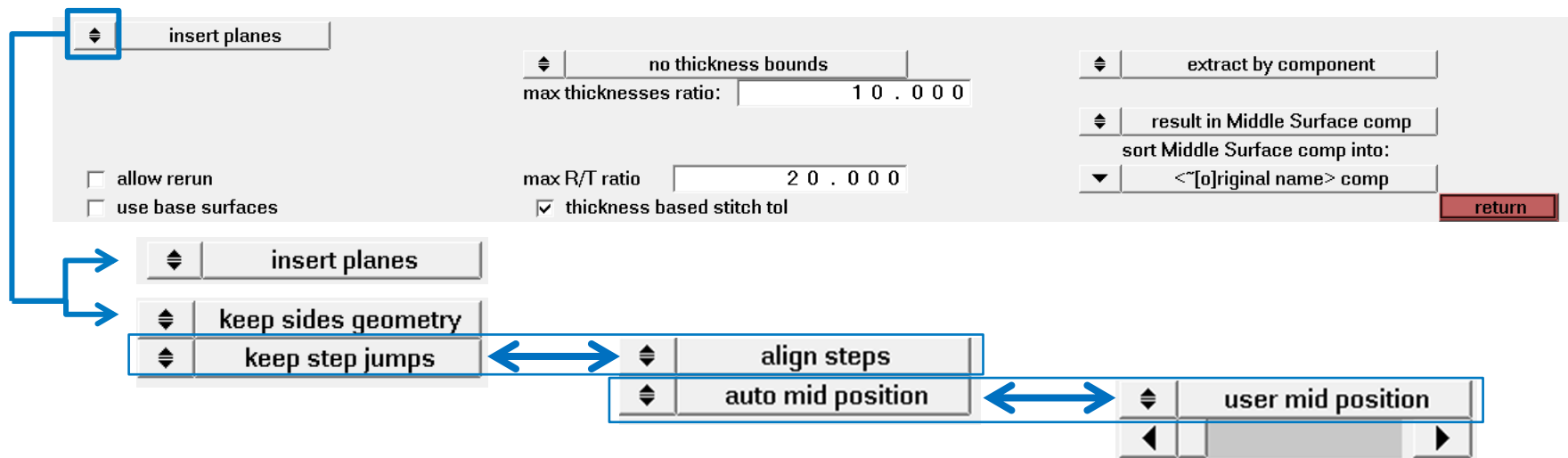
<input checked="" type="checkbox"/> no thickness bounds max thicknesses ratio: 1 0 . 0 0 0	<input checked="" type="checkbox"/> thickness bounds min thickness 0 . 0 0 0 max thickness 1 0 . 0 0 0
---	--

<input type="checkbox"/> extract by component
<input type="checkbox"/> cross components

<input type="checkbox"/> result in Middle Surface comp
<input type="checkbox"/> result in current comp

<input type="checkbox"/> <~[o]riginal name> comp
<input type="checkbox"/> <Midsurface #nn> comp
<input type="checkbox"/> original comp

Insert planes / Keep sides geometry



Insert planes : Surface pairing을 통해 Midsurface 생성. Gap 및 Shared edge 제거에 효과적

Keep step jumps : 서로 다른 두께(step)에 상관없이 Midsurface를 생성

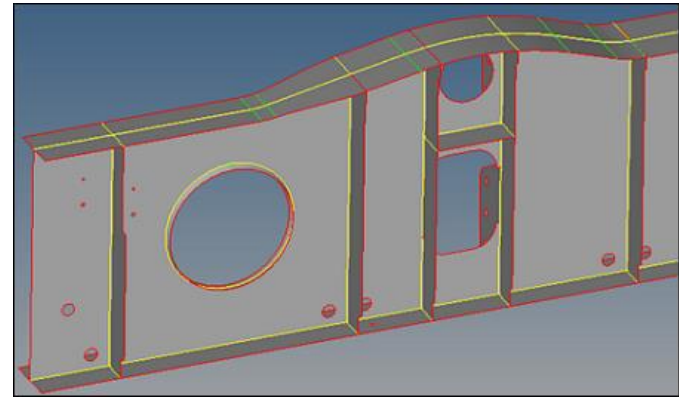
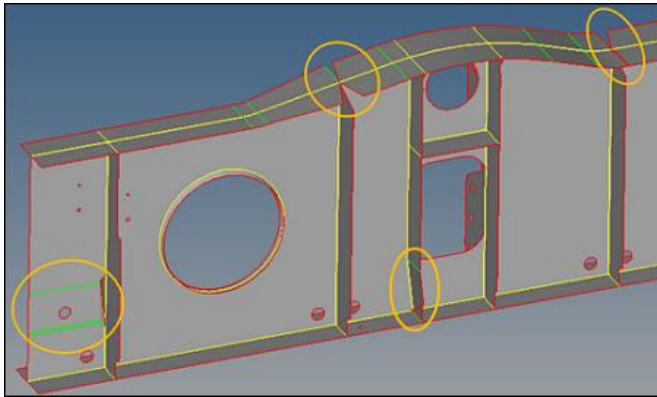
Align steps : 서로 다른 두께(step)를 가지는 형상을 고려하여 Midsurface를 생성

- Solid의 넓은 면을 기준으로 평행하게 생성
- 작은면과 Midsurface 사이의 거리 차이를 offset로 포함하여 생성

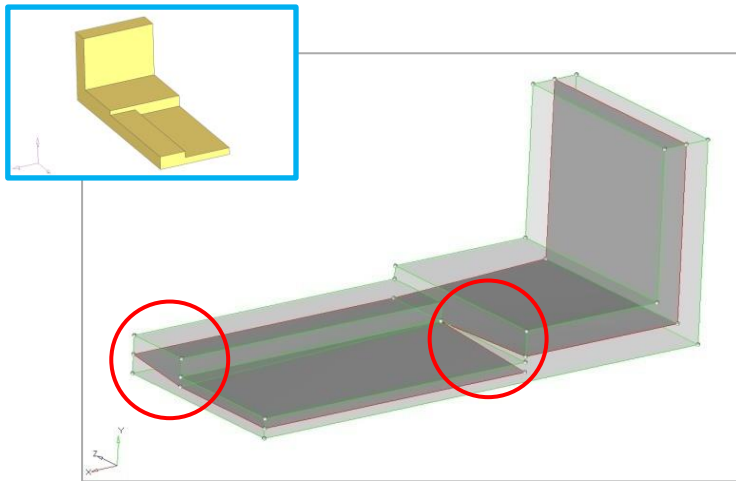
Auto Mid position : Midsurface 의 위치를 자동적으로 생성

User mid position : Midsurface 의 Offset 위치를 사용자가 지정하여 생성

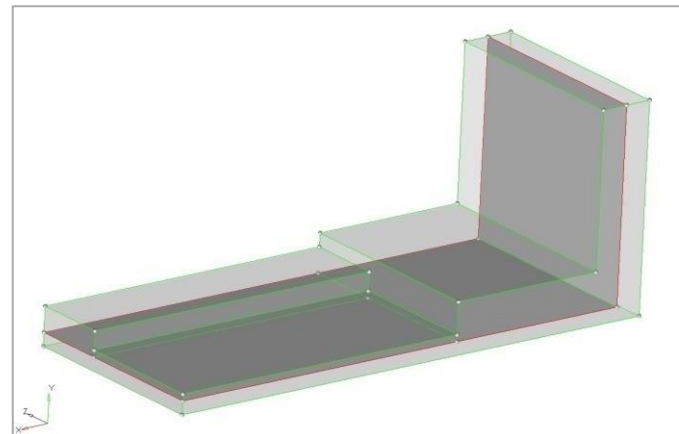
Insert planes / Keep sides geometry (example)



◆ insert planes



◆ keep step jumps



◆ align steps
◆ auto mid position

Thickness bounds options

◆ insert planes	◆ no thickness bounds	◆ extract by component
	max thicknesses ratio: 1 0 . 0 0 0	◆ result in Middle Surface comp
<input type="checkbox"/> allow rerun	max R/T ratio 2 0 . 0 0 0	sort Middle Surface comp into:
<input type="checkbox"/> use base surfaces	<input checked="" type="checkbox"/> thickness based stitch tol	▼ <[o]riginal name> comp
		return

◆ no thickness bounds	max thicknesses ratio: 1 0 . 0 0 0
◆ thickness bounds	min thickness 0 . 0 0 0
	max thickness 1 0 . 0 0 0

: 최대 두께와 최소 두께의 비율을 정의 (default =10)

: Thickness min/max를 정의하여 조건을 만족하지 않는 형상에서는 Midsurface를 추출하지 않음

Extract component options

allow rerun
 use base surfaces

no thickness bounds
 max thicknesses ratio: 1 0 . 0 0 0

max R/T ratio 2 0 . 0 0 0
 thickness based stitch tol

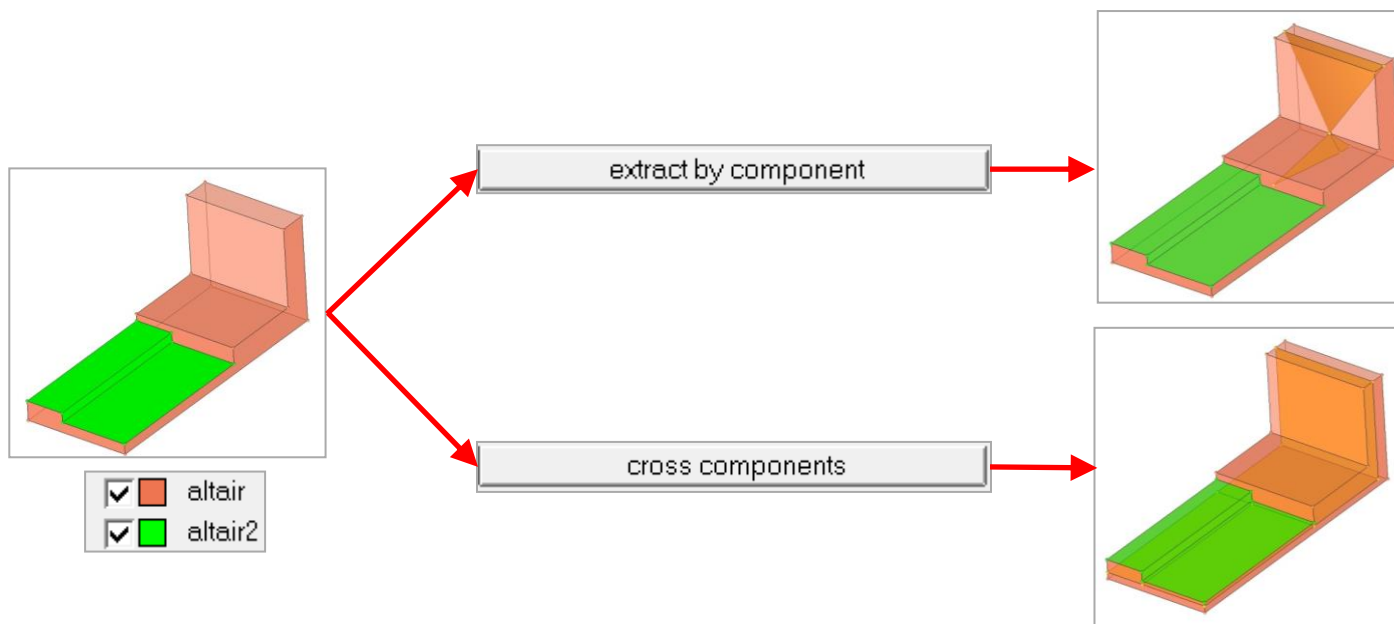
extract by component
 result in Middle Surface comp
 sort Middle Surface comp into:
 <~[o]original name> comp

extract by component

cross components

: 각각의 part를 하나의 part로 인식하여 한번에 Midsurface를 추출하고 하나의 component에 저장
 > 여러 개의 part에서 Midsurface를 추출할 때 유용한 기능

: 단일 형상이 다수의 component로 구성되었을 때 적용



Component result in options

insert planes
 no thickness bounds
 extract by component

max thicknesses ratio:
max R/T ratio
sort Middle Surface comp into:

allow rerun
 thickness based stitch tol
 result in Middle Surface comp

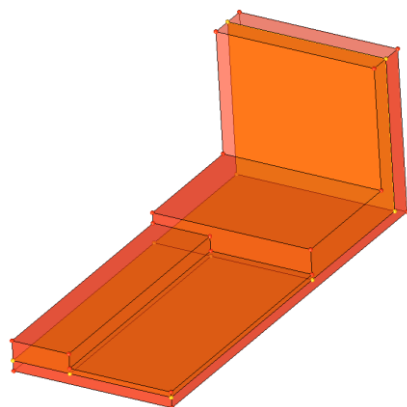
use base surfaces
 <[o]riginal name> comp

result in Middle Surface comp

result in current comp

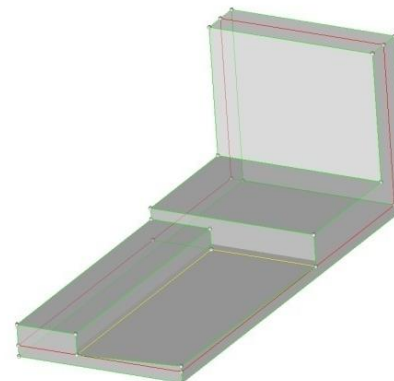
: Middle Surface component를 새로 생성하여 surface을 organize

: Midsurface를 current comp로 설정된 component로 organize



result in Middle Surface comp

altair
 Middle Surface



result in current comp

altair

Middle Surface component sorting options



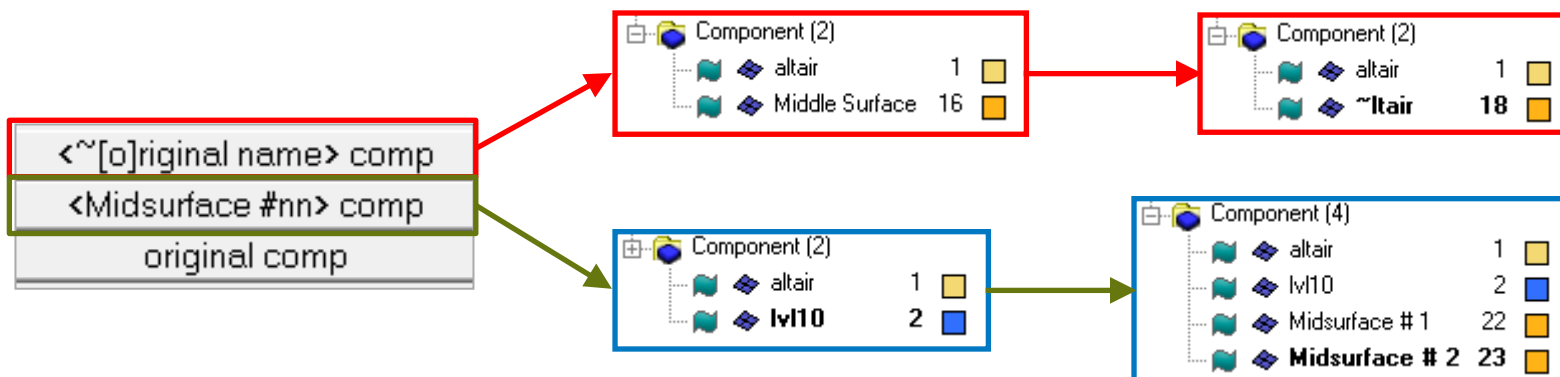
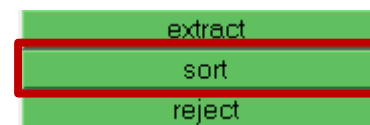
- <~[o]riginal name> comp
- <Midsurface #nn> comp
- original comp

: 원래의 component name에서 첫글자가 ~로 대체되어 rename 됨
 > Ex : altair -> ~ltair

: midsurface 추출 순서대로 component name이 번호를 포함하여 rename됨
 > Ex : Midsurface -> Midsurface # 1, Midsurface # 2

: midsurface가 original component로 organize 됨

✓ 실행 : Sort auction button을 클릭하여 실행



Allow rerun (rerun options activation)

Check on

allow rerun

use base surfaces

no thickness bounds
max thicknesses ratio: 1 0 . 0 0 0

max R/T ratio 2 0 . 0 0 0
 thickness based stitch tol

extract by component

result in Middle Surface comp
sort Middle Surface comp into:
<[original name]> comp

return

auto midsurface surface pair quick edit assign target replace edge extend surface view/assign thickness

surfs closed solid

extraction options...

extract
sort
reject

return

no rerun prepare for rerun do rerun

edit collapsed lines...

trim surfaces with cut line
surfs drag a cut line

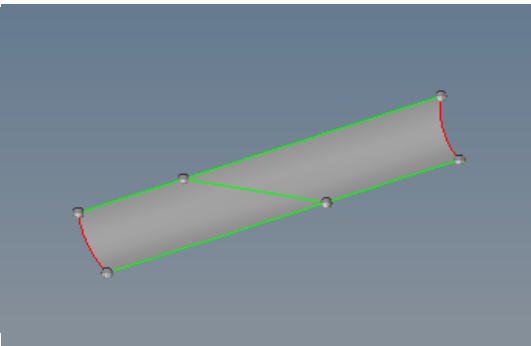
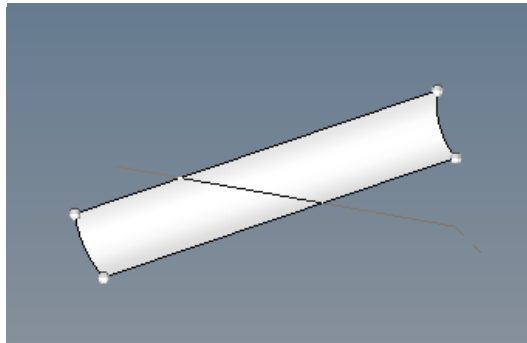
toggle transparency
review

lines to collapse
lines collapse delete reject

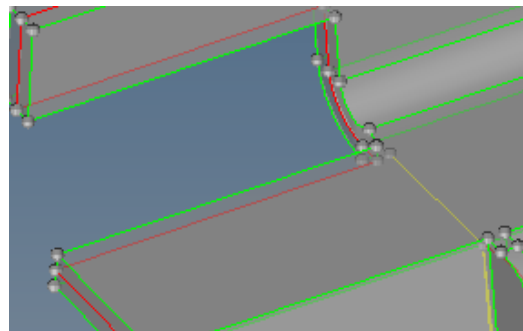
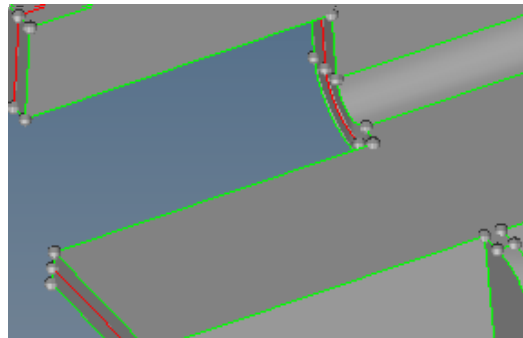
return

Edit collapse lines (Do rerun)

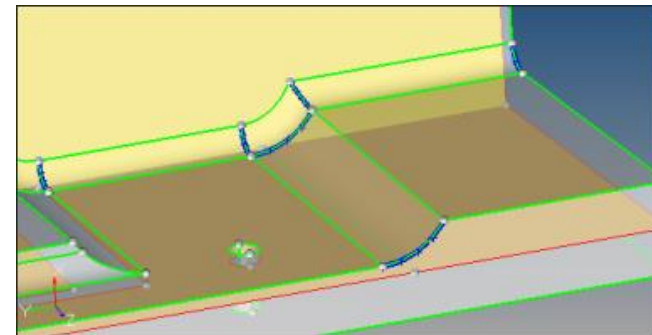
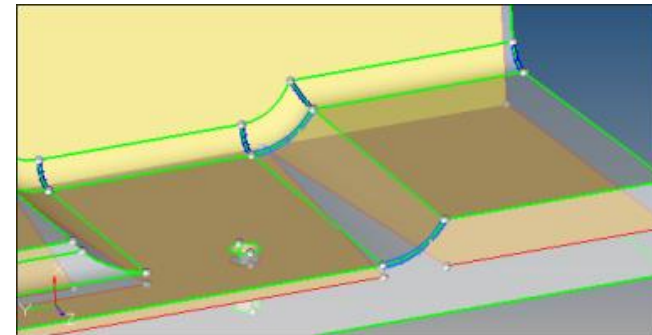
Trim surfaces
with cut lines



Toggle
transparency



Line to collapse



Use base surfaces

insert planes

no thickness bounds
max thicknesses ratio: 1 0 . 0 0 0

extract by component

result in Middle Surface comp
sort Middle Surface comp into:
<[o]riginal name> comp

Check on

allow rerun

use base surfaces

max R/T ratio 2 0 . 0 0 0

thickness based stitch tol

return

- auto midsurface
- surface pair
- quick edit
- assign target
- replace edge
- extend surface
- view/assign thickness

surfs **closed solid**

extraction options...

base surfaces setup...

extract
sort
reject

return

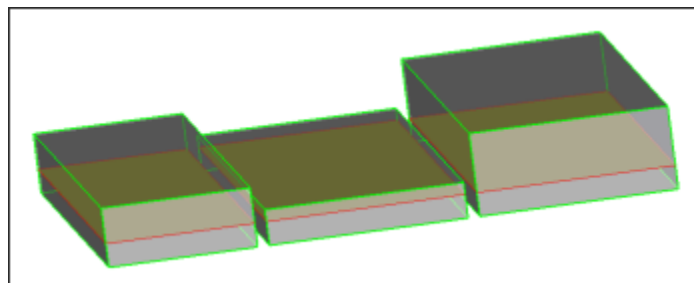
surfs

distance to base 0 . 0 0 0

lock manipulator input

add base
delete base

return



Max R/T ratio

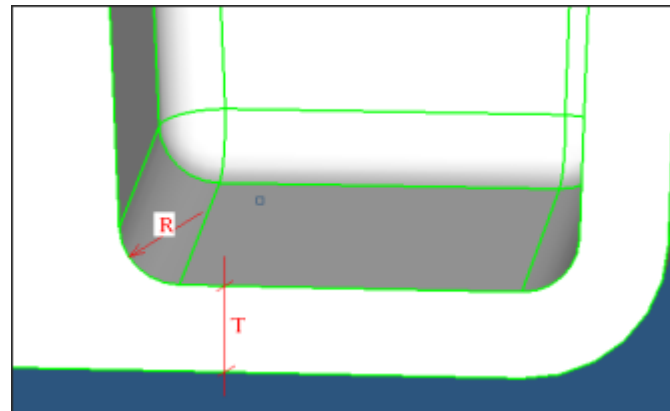
insert planes		no thickness bounds		extract by component	
		max thicknesses ratio: 1 0 . 0 0 0			
<input type="checkbox"/> allow rerun <input type="checkbox"/> use base surfaces		<div style="border: 2px solid red; padding: 2px;"> max R/T ratio 2 0 . 0 0 0 </div> <input checked="" type="checkbox"/> thickness based stitch tol		result in Middle Surface comp sort Middle Surface comp into: <[original name] comp	
					return

이 비율은 T형상, X형상 및 더 복잡한 형상에 대하여 적용된다.

R/T의 비율이 입력한 값보다 커지면 이 부분은 접합점으로 인식되지 않고 솔리드 부분으로 인식된다.

만약 T값이 변하는 형상이라면, 최대값이 사용된다. 필렛이 정확한 원기둥 형상이 아니고 다양한 곡률을 포함하거나, 필렛의 단면이 필렛의 축에 직교하지 않을 때, 실제 필렛의 곡선 길이가 사용되어 원호로부터 R값이 계산된다.

참고적으로, 예전에는 이 값이 2.0이었다.



Connected surfaces Option



✓ Select connected surfaces

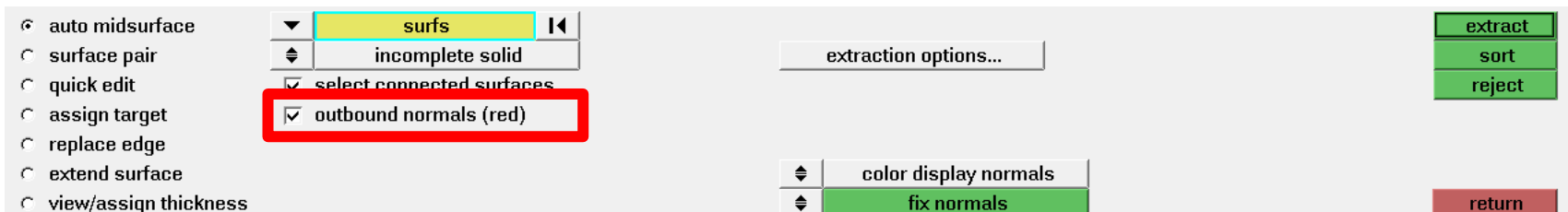
➤ Check on

- 자동적으로 surface를 선택하는 option
- Surface가 서로 공유된 edge를 인식하여 한번에 surface를 선택하고자 할 때 사용

➤ Check off

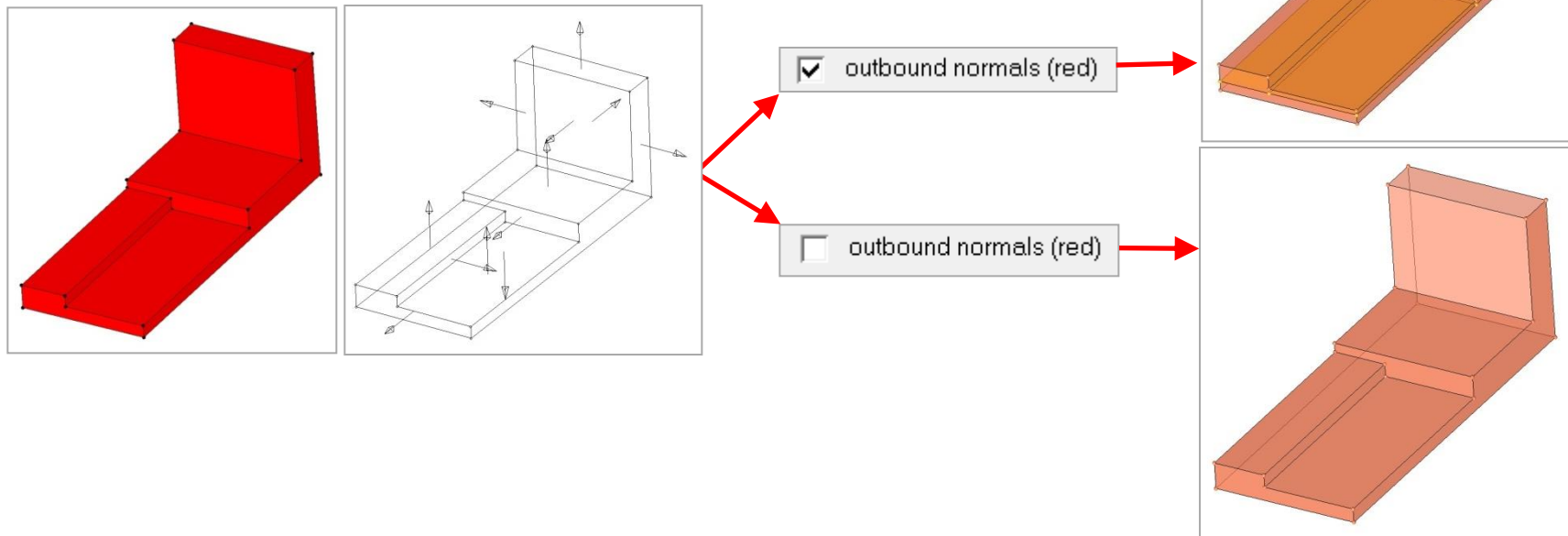
- Check off된 경우는 선택된 surface만이 highlight됨
- user가 일일이 클릭하여 선택 해야하는 경우에 사용

Outbound normals (red)

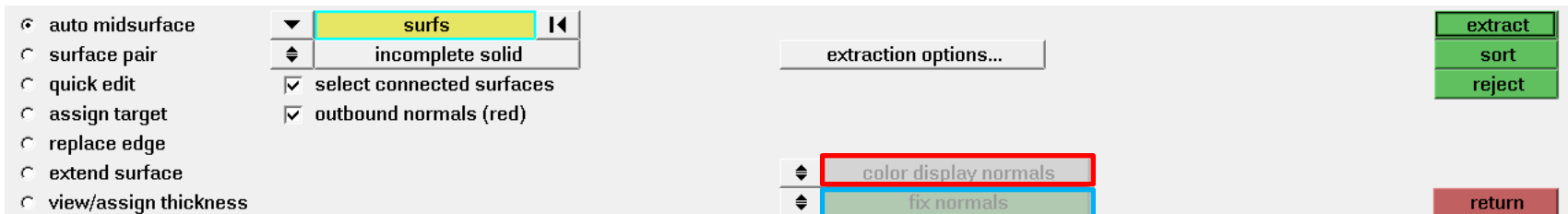


✓ Surface normal 방향에 따라 midsurface를 추출하는 방법을 정의

- Midsurface 추출시 surface normal 방향을 반드시 구별해야 함
- Check on : Enclosed Volume의 normal이 volume의 바깥으로 향할 때

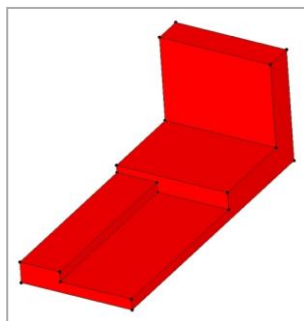


Fix normals / Reverse normals / Display normals

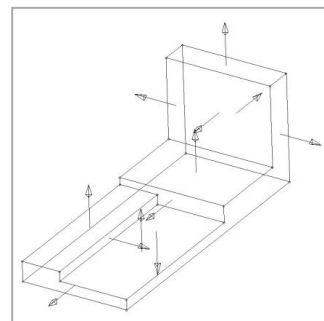


✓Color Display normals : Surface Normal 방향을 color로 표현
(vector의 방향 : 바깥 = red, 안쪽 = blue)

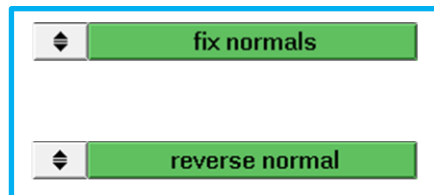
✓Vector : Surface Normal 방향을 Vector로 표현



< Color display normals >



< Vector display normals >



✓Fix normals : 선택한 모든 surface의 normal을 자동으로 fix

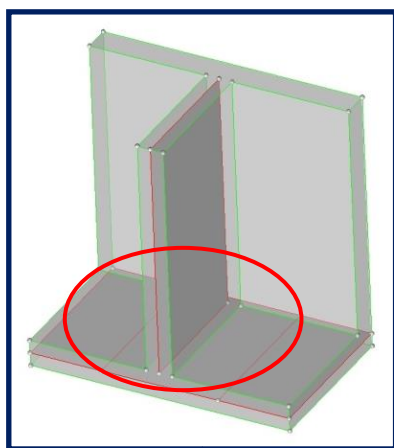
✓Reverse normals : Surface normal 방향이 다르게 정의된 경우 normal 방향을 수정

-
- Auto Midsurface
 - **Surface pair**
 - Quick edit
 - Assign target
 - Replace edge
 - Extend surface
 - View thickness

Surface pair

<ul style="list-style-type: none"> <input type="radio"/> auto midsurface <input checked="" type="radio"/> surface pair <input type="radio"/> quick edit <input type="radio"/> assign target <input type="radio"/> replace edge <input type="radio"/> extend surface <input type="radio"/> view/assign thickness 	<p>side1</p> <p style="background-color: yellow; border: 1px solid black; padding: 2px;">surf</p> <p>side2</p> <p style="background-color: yellow; border: 1px solid black; padding: 2px;">surf</p>	<p>extraction options</p> <p><input type="checkbox"/> combine with adjacent plates</p> <p><input type="checkbox"/> combine all adjacent plates</p> <p>result in Middle Surface comp</p>	<p>extract</p> <p>reject</p> <p>return</p>
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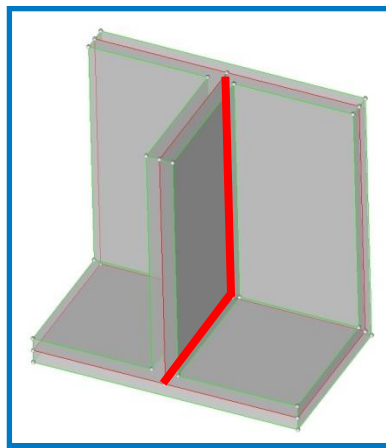
- **Combine with adjacent plates** : 주변 midsurface의 형상을 고려하고, extend, trim, project 등의 기능을 수행하여 주변 midsurface와 만나는 edge를 **free edge**로 생성 (shared edge로 만드는 추가 작업 수행필요)
- **Combine all adjacent plates** : 위 option과 같은 기능을 하며, edge를 **shared edge**로 연결함



extraction options

combine with adjacent plates

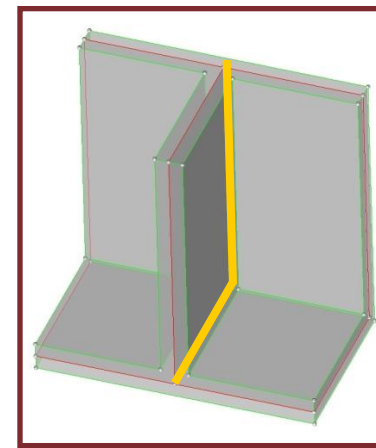
combine all adjacent plates



extraction options

combine with adjacent plates

combine all adjacent plates



extraction options

combine with adjacent plates

combine all adjacent plates

-
- Auto Midsurface
 - Surface pair
 - **Quick edit**
 - Assign target
 - Replace edge
 - Extend surface
 - View thickness

Quick Edit

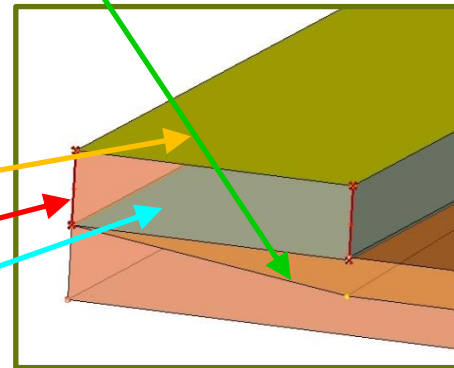
auto midsurface
 surface pair
 quick edit
 assign target
 replace edge
 extend surface
 view/assign thickness

target type:
 target location:
 show original midsurface
 equiv to

surface:
 point to offset:
 pilot point:

Component (5)

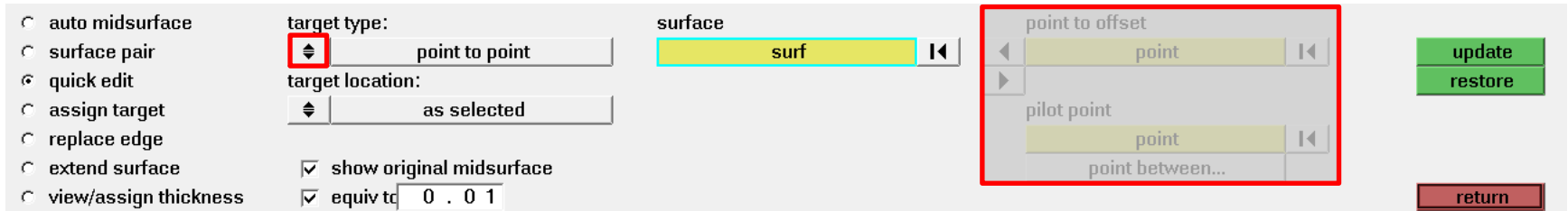
- altair 1
- Middle Surface 309**
- Surface to offset 362**
- Targets 363**
- Midsurface to edit 361**



✓ 추출된 midsurface를 빠르게 수정

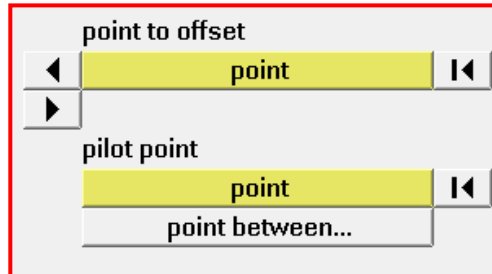
- 잘못 추출된 midsurface를 수정하고자 할 때 적용
- 3개의 temporary component가 생성, 이는 midsurface panel을 나오면 자동 삭제됨
 1. **Surface to offset (yellow)** : Midsurface 추출을 위해 사용한 source surface
 2. **Targets (red)** : user가 사용하는 handle (using point or edge)
 - Offset의 거리와 방향을 정의
 - Target은 user가 임의 생성 불가 (Assign Target에서 가능)
 3. **Midsurface to edit (cyan)** : Update 버튼을 클릭했을 때 수정되는 midsurface 형상

Quick Edit



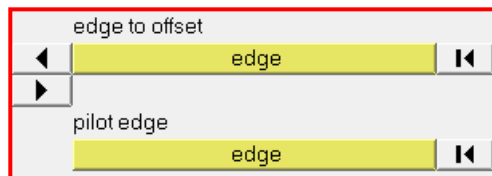
✓ **Point / edge to offset : surface to offset으로 선택된 surface에서 point or edge를 선택**

- Surface to offset으로 선택한 surface가 아닌 다른 surface에서 선택하면 활성화 되지 않음
- 선택되면 **붉은색 원**으로 표시됨



✓ **Pilot point / edge : 위의 option에서 선택한 entity를 offset할 위치의 point / edge**

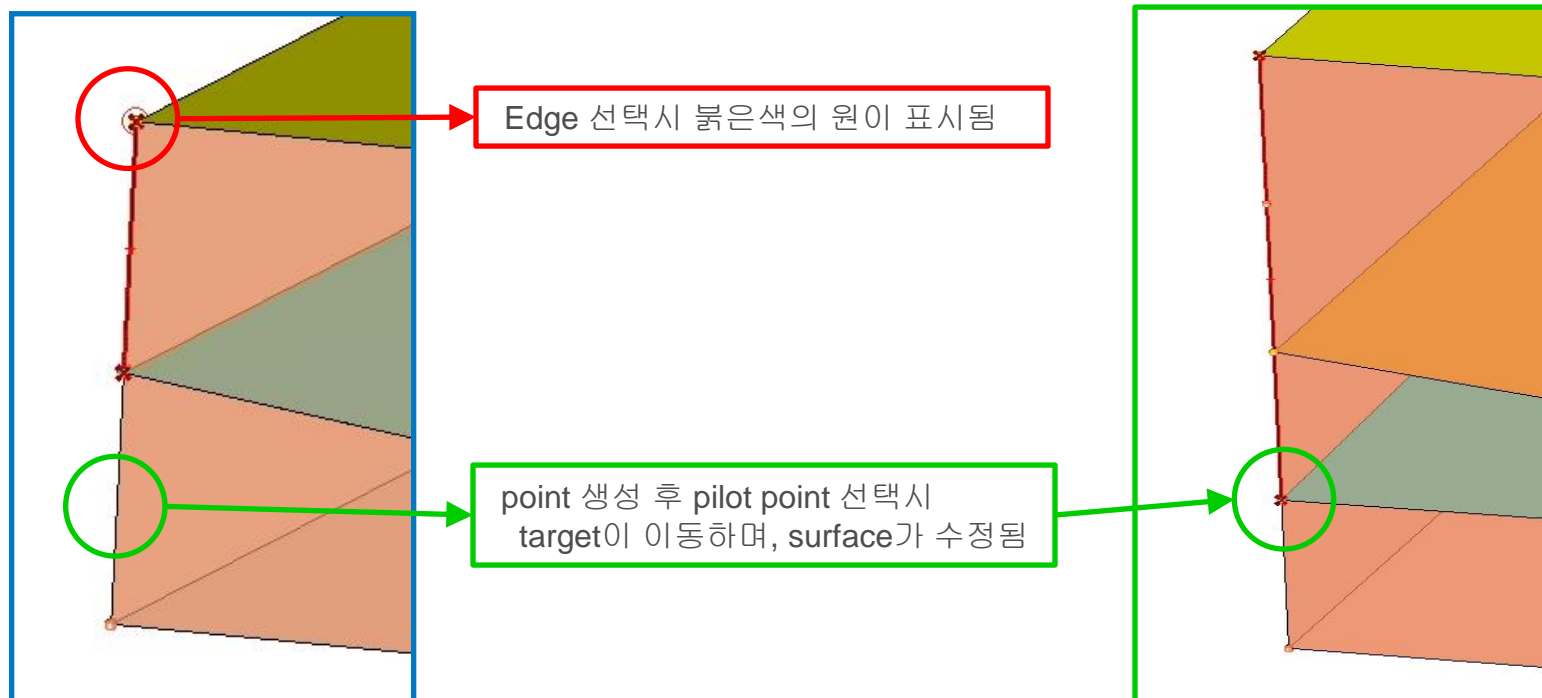
- 수정 도중에 quick edit (F11)를 이용하여 fixed point를 생성하여, offset할 point를 생성할 수 있음



Quick Edit (Example)

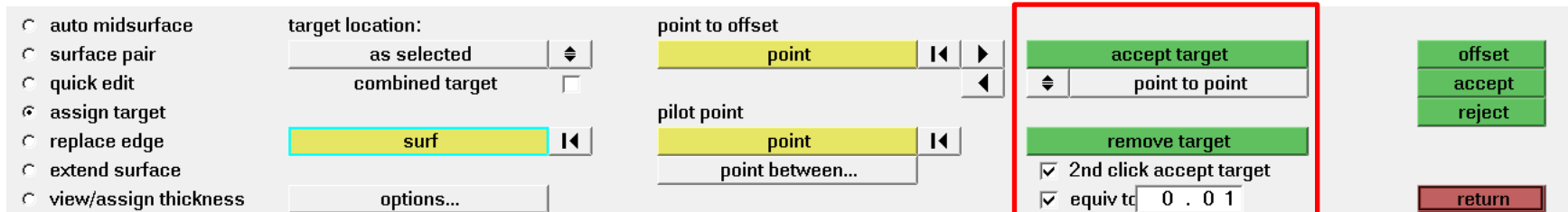
✓ Process

1. 수정할 midsurface를 선택 (surface to offset으로 정의됨)
 2. 이동하고자 하는 target의 point 또는 edge를 선택 - 붉은색 원이 표시됨을 확인 (그림 참조)
 3. 선택한 point (edge)가 옮겨질 point (edge)를 선택 - target이 옮겨짐을 확인
 4. Update 버튼 클릭
- ❖ Restore : 최종 Update 내용을 reset



-
- Auto Midsurface
 - Surface pair
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 - **Assign target**
 - Replace edge
 - Extend surface
 - View thickness

Assign Target



✓ Target을 user가 생성 또는 삭제 하여 surface를 수정할 방향을 설정

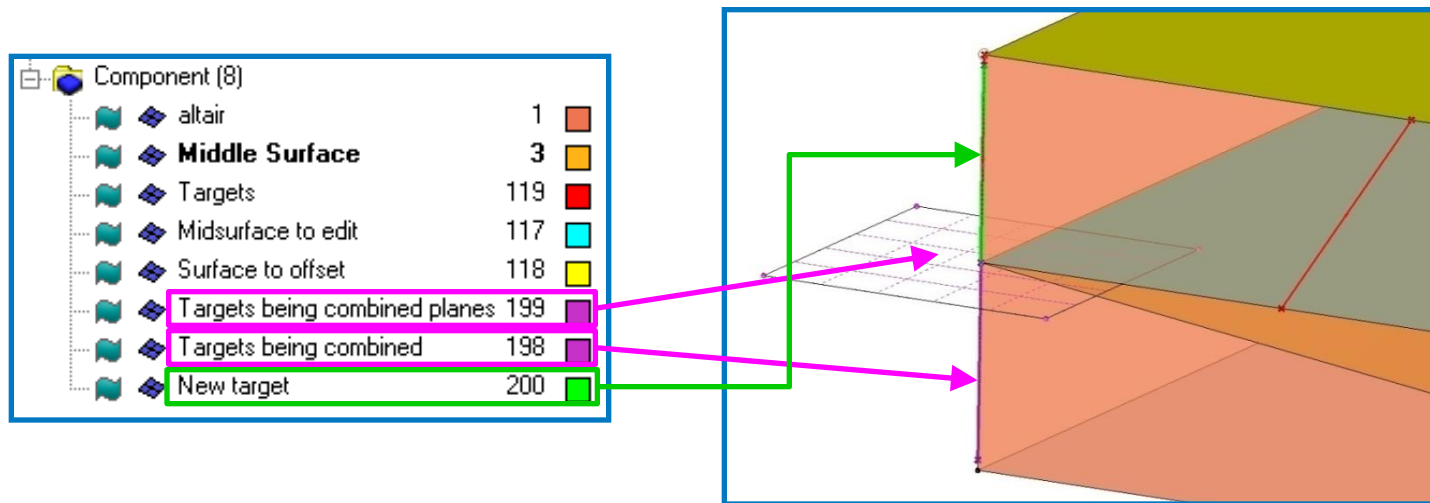
- **Accept target / remove target** : target을 생성(accept) 또는 삭제(remove)하는 버튼
- **2nd click accept target** : Green으로 보이는 Target을 마우스 1번 버튼을 클릭하여 빨간색의 target으로 update
- **Equiv tol** : target의 공차 정의

✓ Quick edit와 차이점

- Point to offset에서 point를 선택한 후 pilot point를 정의했을 때
 - **Quick edit** : target이 수정되면서 자동으로 빨간색 정의됨
 - **Assign target** : 녹색 target 으로 나타나며, accept target을 클릭해야만 빨간색의 target 으로 정의됨

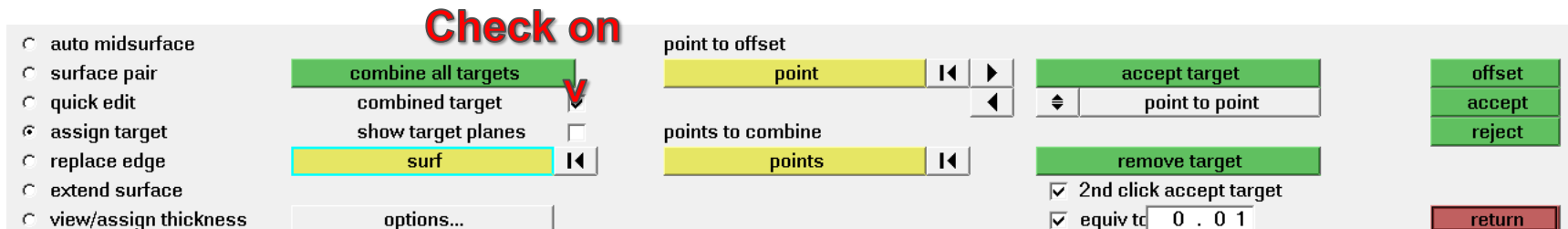
Assign target – temporary component

- ✓ Quick edit의 temporary component 이외에 3개의 component가 추가로 생성됨
 - Targets being combined planes와 Targets being combined는 combine target이 check on되어야 생성됨
 - **New Target (Green)** : user가 생성하고자 하는 target
 - **Target being combined (purple)** : 선택한 경로를 포함하는 target
 - **Target being combined plane (purple)** : Target이 지정되는 plane



Assign target - Combine target

Check on



auto midsurface
 surface pair
 quick edit
 assign target
 replace edge
 extend surface
 view/assign thickness

combine all targets
 combined target
 show target planes

surf

options...

point to offset
point

points to combine
points

accept target
point to point

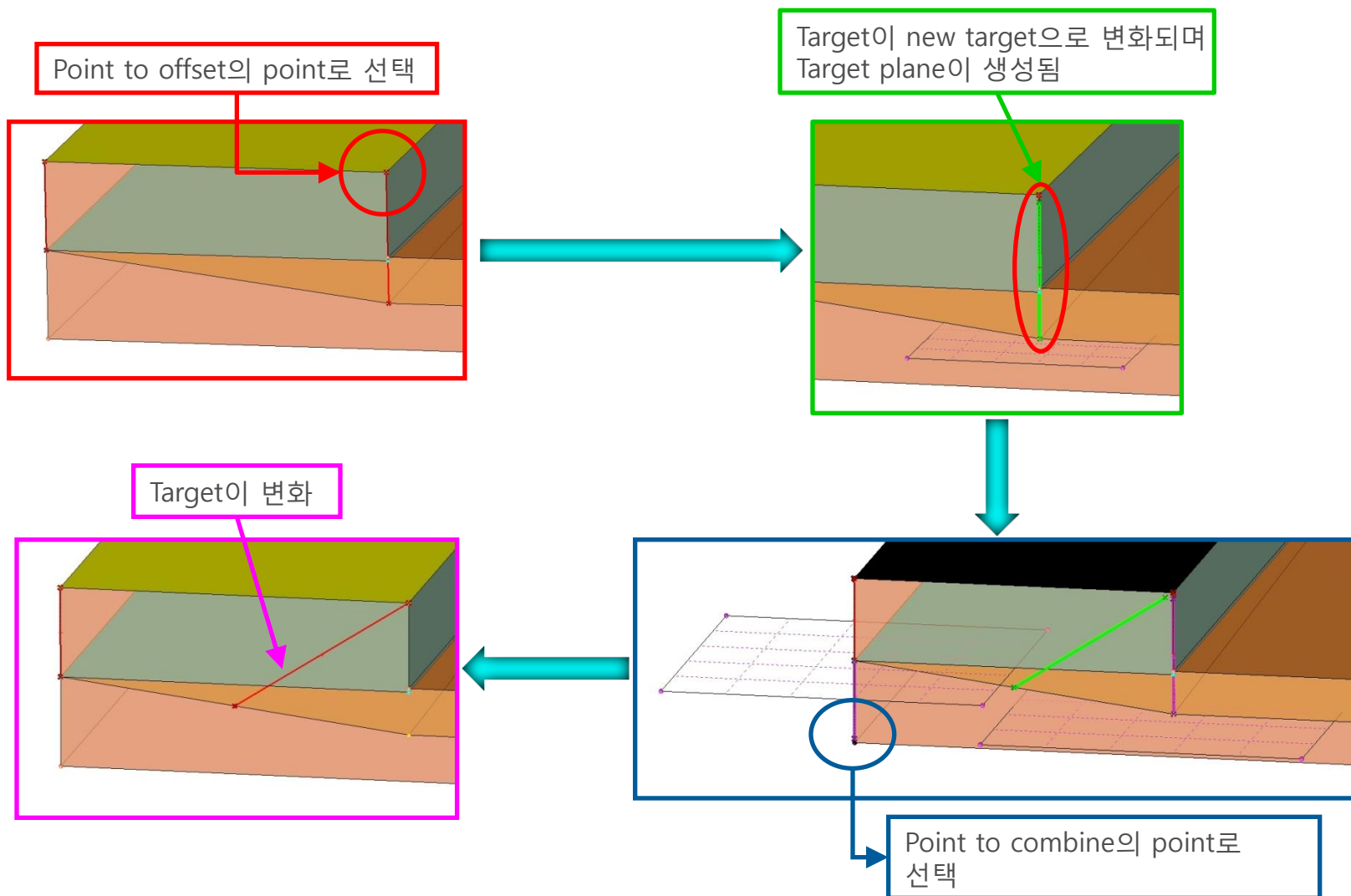
remove target
 2nd click accept target
 equiv to 0 . 0 1

offset
 accept
 reject
 return

✓ Combine target (point to point에서 적용)

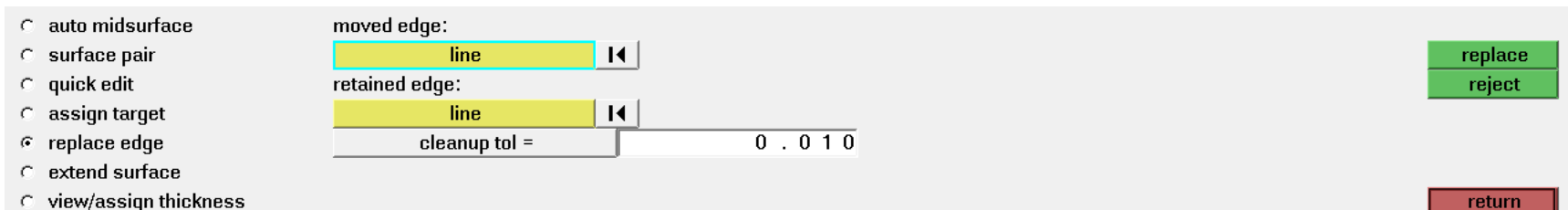
- **Point to offset** : Quick edit와 동일, target이 정의된 point만 선택됨
- **Points to combine** : Target의 방향을 변화시키기 위해서 combine 하고자 하는 point를 선택
- **Show target planes** : Target plane의 display on/off

Assign target - Combine target (Example)



-
- Auto Midsurface
 - Surface pair
 - Quick edit
 - Assign target
 - **Replace edge**
 - Extend surface
 - View thickness

Replace edge



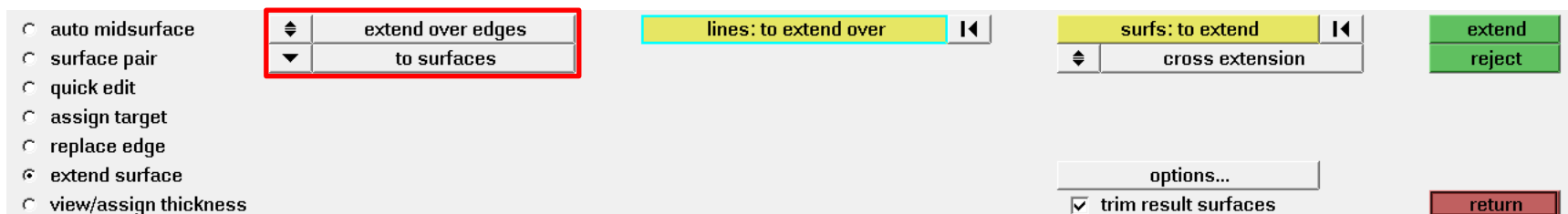
✓ Edge를 이동하여 다른 edge에 replace 하는 기능

- Retained edge : 고정되는 edge (Destination edge)
- Edge to move : 이동하려는 edge

❖ Edge edit panel > replace edge panel로 같은 기능을 수행할 수 있음

-
- Auto Midsurface
 - Surface pair
 - Quick edit
 - Assign target
 - Replace edge
 - **Extend surface**
 - View thickness

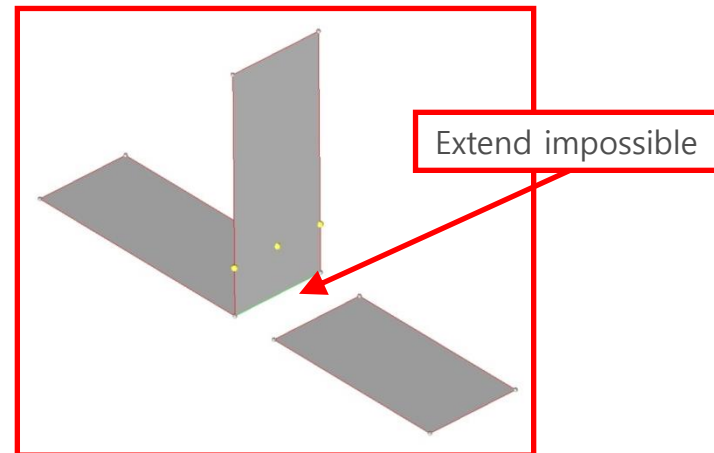
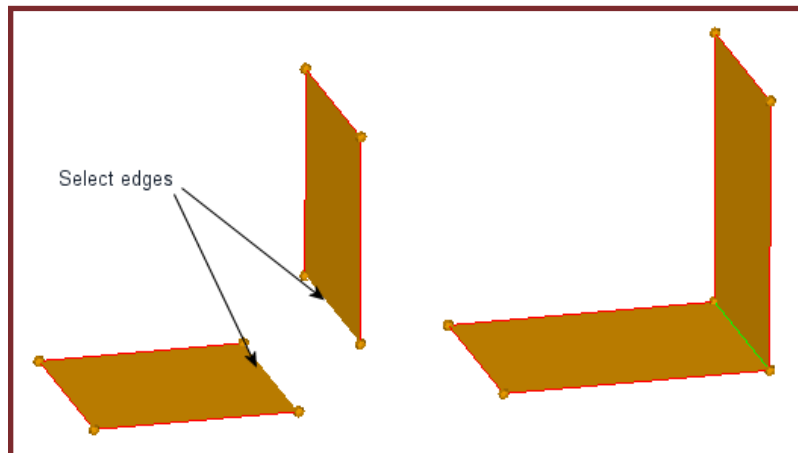
Extend surface – Extend over edges



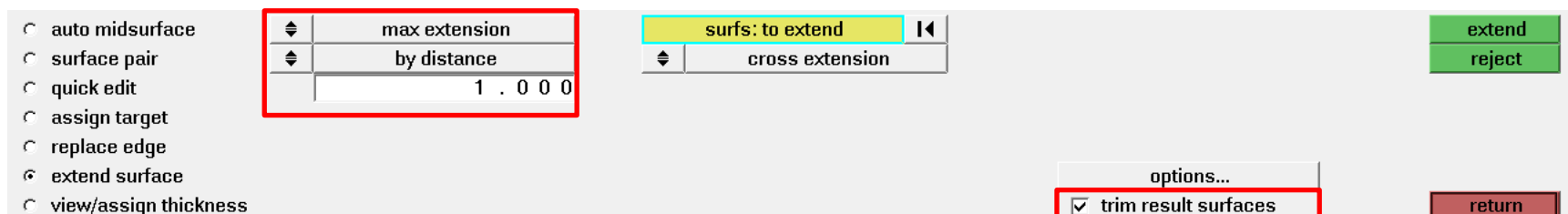
✓ **Extend surface 기능이란?** : Edge를 연장하여 다른 edge나 surface와 연결

✓ **Extend over edges** : 연장하려는 surface의 edge를 다른 surface와 연결

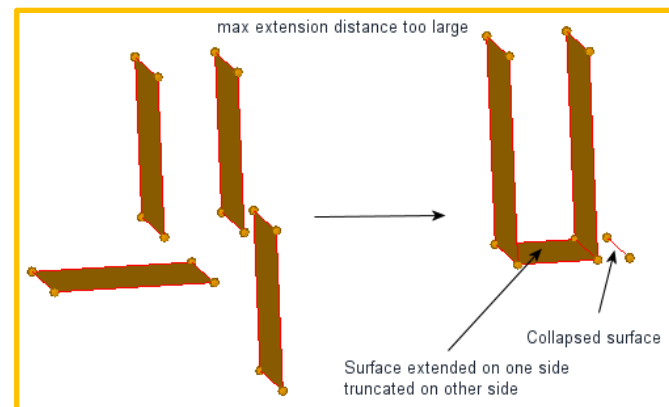
- Free edge만 선택 가능
- 하나의 edge만이 확장되는 경우에는 적합하지 않음 (그림 참조)



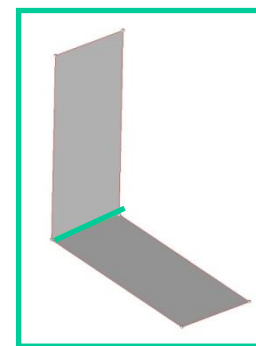
Extend surface – Max extension



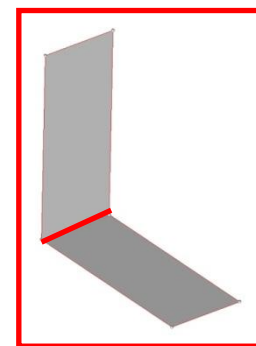
- **Max extension** : 오차범위를 만족하는 surface edge가 확장
 - ❖ 주의 : 임의대로 오차를 크게 부여하게 되면 연장되거나 잘려져서는 안 될 edge까지도 수정되므로, Max 값을 부여할 때 주의



- **Trim** : Check On – 연장되어 만나는 edge를 shared edge로 변환
 Check Off – 연장되어 만나는 edge를 free edge로 변환

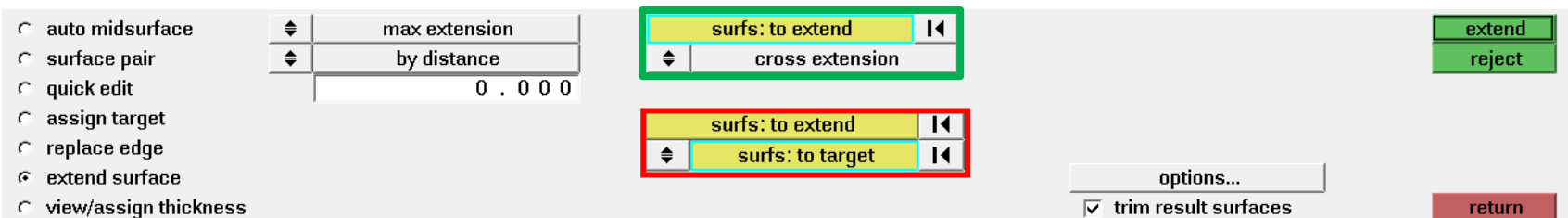


< Trim Check ON >



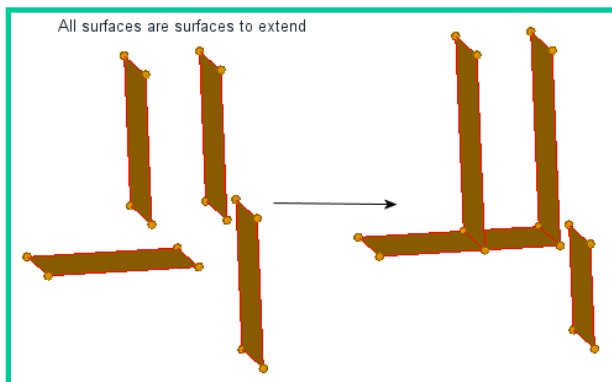
< Trim Check OFF >

Extend surface – surface: to extend

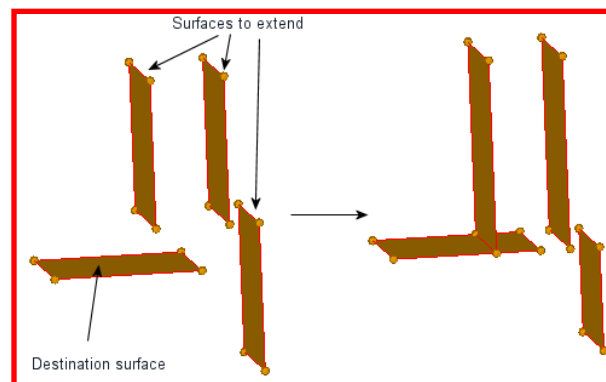


< Extend surface – surfaces to extend (cross extensions check OFF) >

- **Cross extension** : 선택된 surface가 연장되어 edge를 생성 (왼쪽 그림 참조)
- **Destination surfaces**
 - Cross extensions option이 check OFF 된 경우에 나타남
 - 선택된 surface는 연장하고자 하는 surface와는 달리 변화가 없음 (오른쪽 그림 참조)



< Cross extensions check ON >



< Cross extensions check OFF >

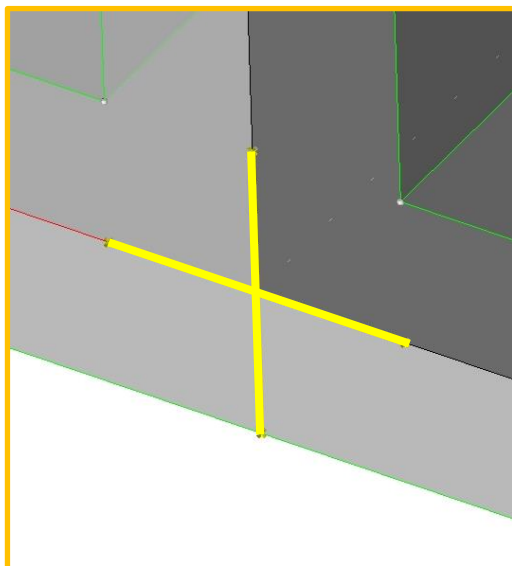
-
- Auto Midsurface
 - Surface pair
 - Quick edit
 - Assign target
 - Replace edge
 - Extend surface
 - **View thickness**

<ul style="list-style-type: none"><input type="radio"/> auto midsurface<input type="radio"/> surface pair<input type="radio"/> quick edit<input type="radio"/> assign target<input type="radio"/> replace edge<input type="radio"/> extend surface<input checked="" type="radio"/> view/assign thickness	<p>view thickness</p> <p>surfs <input type="button" value="◀"/></p> <table border="1"><tr><td>average thickness:</td><td>0 . 0 0 0</td></tr><tr><td>max thickness:</td><td>0 . 0 0 0</td></tr><tr><td>min thickness:</td><td>0 . 0 0 0</td></tr></table>	average thickness:	0 . 0 0 0	max thickness:	0 . 0 0 0	min thickness:	0 . 0 0 0	<p>assign thickness</p> <p>surfs <input type="button" value="◀"/></p> <p>new thickness: <input type="text" value="1 . 0 0 0"/></p> <p><input type="button" value="return"/></p>
average thickness:	0 . 0 0 0							
max thickness:	0 . 0 0 0							
min thickness:	0 . 0 0 0							

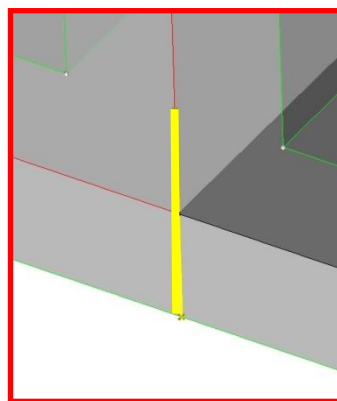
View thickness

<ul style="list-style-type: none"> <input type="radio"/> auto midsurface <input type="radio"/> surface pair <input type="radio"/> quick edit <input type="radio"/> assign target <input type="radio"/> replace edge <input type="radio"/> extend surface <input checked="" type="radio"/> view/assign thickness 	<p>view thickness</p> <p>surfs <input type="text" value="surfs"/></p> <p>average thickness: <input type="text" value="0.0000"/></p> <p>max thickness: <input type="text" value="0.0000"/></p> <p>min thickness: <input type="text" value="0.0000"/></p>	<p>assign thickness</p> <p>surfs <input type="text" value="surfs"/></p> <p>new thickness: <input type="text" value="1.0000"/></p> <p><input type="button" value="return"/></p>
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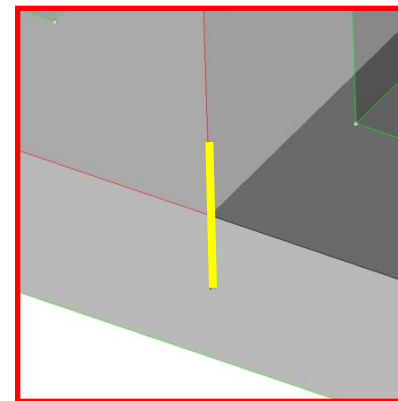
- ✓ Midsurface에 정의된 thickness를 확인
 - Midsurface panel로 생성된 surface만이 thickness 정보를 가짐
 - Thickness 값은 Tcl function에 의해서 추출 가능
 - **Set thickness** : 지정한 수로 Thickness 값을 수정하는 기능



< View Thickness 예제 >



< 원래 두께값 = 10 >



< 새로운 두께값 = 5 >

Midsurface Thickness Map

- ✓ Midsurface가 가진 thickness를 element에 assign 하는 macro
 - 위치 : Tap area > Utility menu > Geom/Mesh > Midsurf Thickness...
 - **Assign thickness to** : 두께값을 부여할 entity를 정의
 - **Thickness calculation method** : midsurface로부터 두께값을 얻는 방법을 정의
 - **Average** : node가 가진 두께값의 평균을 적용
 - **Centroid** : node의 두께값을 보간하여 element의 중심에 적용
 - **Max / Min** : nodal thickness의 최대값 / 최소값을 적용


Assign thickness to:

Nodes, property on elements
 Nodes, property on components
 Elements
 Properties on elements
 Properties on components
 Organize only
 Use Z-offset values

Thickness calculation method:

Nodal values
 Average
 Centroid
 Max
 Min

Organization method:

Gauge file: 
 Range interval:

Midsurface Thickness Map

- Component organization method : 같은 두께값을 갖는 element 그룹을 각각의 component에 organize 할 때, 두께값의 간격 (interval)을 정의
 - **Gauge** : user가 만든 파일을 기준으로 두께 범위를 정의
 - **Range Interval** : user가 입력한 수를 기준으로 두께 범위를 정의
 - **Range 값을 정의하지 않으면 두께가 부여되지 않음**

- Gauge 파일 형식

```

Number of Gauges
[Number of Gauge Data Lines]
Gauges
Begin          End          Assigned Value
[min Thk]      [max Thk]    [Assigned Thk]
  
```

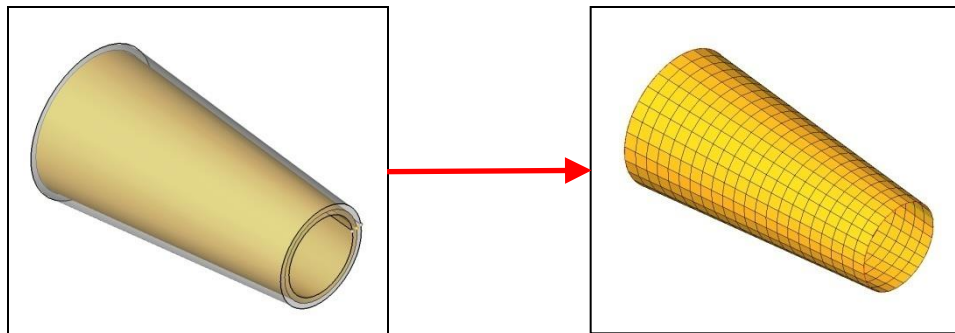
```

Number of Gauges
4
Gauges
Begin          End          Assigned Value
0.0            0.05        0.05
0.05           0.1         0.1
0.1            0.15        0.15
0.15           0.2         0.2
  
```

Midsurface Thickness Map (example – nodes/elements)



- ✓ 아래 그림과 같이 midsurface를 생성하고, automesh를 이용하여 surface mesh를 생성함



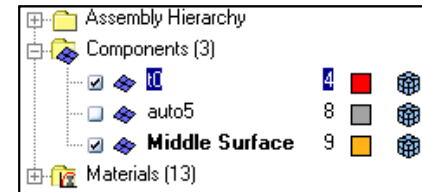
- ✓ Assign 버튼을 클릭하고 나타난 sub-panel에서 element를 선택하면 각 element의 node에 두께가 부여됨.

	EID	PID	G1	G2	G3	G4
CQUAD4	5857	9	6198	6197	6214	6211
			T1	T2	T3	T4
			4 . 4 5 3	4 . 4 1 5	4 . 4 1 5	4 . 4 5 3

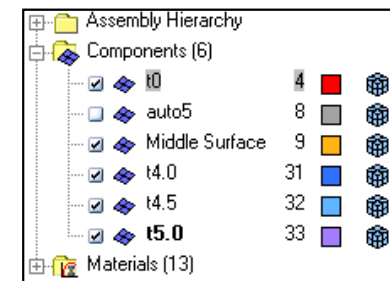
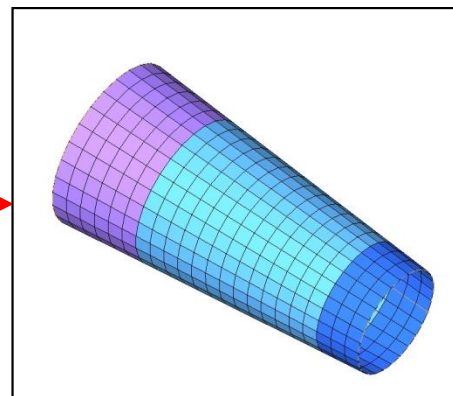
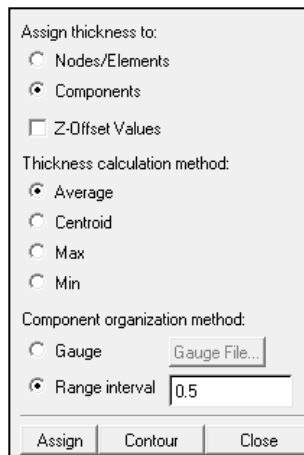
< card editor에서 확인 >

Midsurface Thickness Map (example – Components)

- ✓ 새로운 component를 생성 (생성이유 : 각각 적용된 user profile에 따른 component property의 적용을 위해서)
 - Name : t0 (의미 : “t[thickness value]”)
 - Card image : **Pshell (userprofile : Optistruct)**
 - Thickness : blanks
 - t0 component를 기초로 새로운 component가 생성되므로 반드시 생성해야함

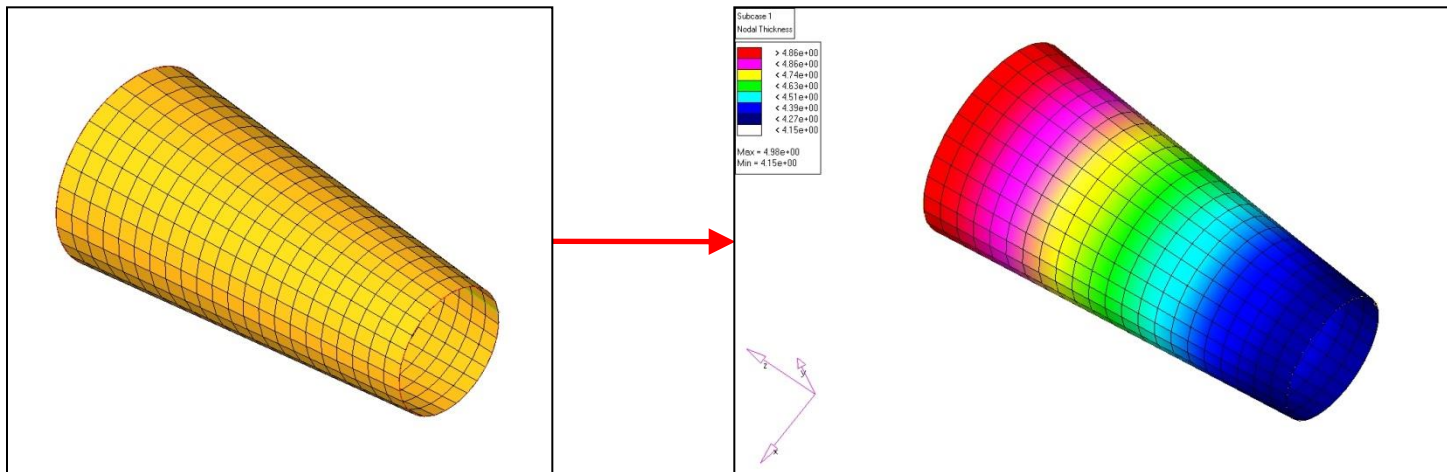


- ✓ 왼쪽 그림과 같은 항목을 선택하고 assign 시키면 가운데 그림과 같이 두께가 부여되고, 새로운 component가 생성됨 (0.5간격의 component 생성되고 해당 element가 organize됨)
 - ✓ Assign thickness to : **Components**
 - ✓ Thickness calculation method : **Average**
 - ✓ Component organization method : **Range interval = 0.5**



Midsurface Thickness Map (example - contour)

- ✓ Contour 버튼을 클릭하면, 부여된 두께를 contour로 볼 수 있음
 - ✓ Node thickness 값을 contour로 display
- ✓ 두께를 부여하기 전에도 Contour를 이용하여 부여될 두께를 볼 수 있음



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기타 문의처 : help@altair.co.kr

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